United States Department of the Interior

U. S. GEOLOGICAL SURVEY
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Denver Federal Center
Denver, Colorado 80225

IN REPLY REFER TO

INFORMATION ONLY

December 11, 2002

Victor W. Trebules
Director, Office of Project Control
Yucca Mountain Site Characterization
Project Office
U. S. Department of Energy
P.O. Box 364629
Las Vegas, Nevada 89036-8629

SUBJECT: Yucca Mountain Project Branch - U.S. Geological Survey (YMPB-USGS) Progress Report, November, 2002

Attached is the USGS progress report in the required format for the month of November, 2002.

If you have any questions or need further information, please call Raye Ritchey Arnold at (303)236-5050, ext 296.

Sincerely,

Raye Ritchey Arnold
for Robert W. Craig
Technical Project Officer
Yucca Mountain Project Branch
U.S. Geological Survey

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U.S. GEOLOGICAL SURVEY
YUCCA MOUNTAIN PROJECT, EXECUTIVE SUMMARY

November 2002

GEOLOGY

On-going USGS support to interpretation of lithostratigraphy of the Nye County early-warning drilling continued, as two technical reviews were conducted on the Phase III lithostratigraphic data package. Responses were made to technical review comments, author responses were accepted by the reviewers, and the data package was sent to USGS data management for a "checker" review. Revisions to cross sections Nye-1, Nye-2, and Nye-3 have been made, and the cross sections have been "colorized" to expedite the technical review process. A poster currently is being constructed that will present not only those colorized cross sections but also locations of key geologic and geophysical information used in the construction of Nye-1, Nye-2, and Nye-3 sections. Data used in the cross sections, which are currently scattered, will be consolidated in that poster and thereby provide a clear foundation for those sections.

Clarifications have been suggested for text accompanying the recently completed geologic map of the potential southern expansion area of the proposed repository. That map currently is in review for DOE concurrence and USGS Director's approval. Preparations for publication of that map also continued.

Several aspects of underground geology and materials testing continued. Preparation of an ECRB data package (containing information from mechanical testing of rock from the Cross Drift) continued during the month, with focus on direct-shear data. Laboratory rock testing was hindered by calibration issues, but several samples were prepared and are ready for testing. Additional staff was temporarily used for assistance in creep testing. As work continued in determination of fracture and lithophysal characteristics of the repository host horizon (RHH), reduction of data inputs for the Tptpln, Tptpll, and Tptpul rock units continued. Spreadsheet compilations included fracture data from the Cross Drift, the ESF, and various alcoves. On-going work was directed to selection of sampling locations for thin sections. Planning was underway for fault-related fracture studies and small-scale fracture traverses. Compilation of the fracture and lithophysal data base also continued.

Acquisition of data to quantify lithophysal porosity proceeded, and data collection and summarization for Slot Test #2 and Slot Test #3 continued into fiscal year (FY) 2003; completion of the Slot Test #2 summary is described in detail below. Basic configuration of Slot Test #3 is similar to Slot Tests #1 and #2, but Test #3 is located in the invert of the Cross Drift at Station 21+25. The actual test lay-out (as in the previous Test #1 and Test #2) consists of two 1.5-m-deep vertical slots (named Slot-A and Slot-B) and a central 30.5-cm-diameter, 1.8-m-deep vertical borehole. Minor modifications of the methodology of data collection have been made using experience of the previous tests to refine and enhance the data. Collection of Test #3 data is underway on the size, shape,

and distribution of lithophysal cavities, rims, and spots in development of two slot maps, a borehole map, and a "panel" map of the invert.

A summary of the distribution of lithophysal cavities and fractures in the host rocks for Slot Test #2 was delivered to the Sandia National Laboratories analytical team. Those data and the summary are in technical and checker review. Abundances of the matrix (groundmass) and lithophysal cavities were determined with panel, borehole, and slot maps. The "panel map" is an overlay on a photograph of the tunnel wall, the "borehole map" is based on a borehole video recording, and the "slot maps" are composites of 20 video-recording runs in each slot. Techniques used to compile the panel, borehole, and slot maps are fairly new but result in good-quality, spatially registered, feature-specific data. An important method employed in the Slot Test #2 analyses is the hierarchical evaluation of lithophysal cavities with respect to resolution of the mapping techniques. In short, video recordings of the slots provide great detail (the ability to identify and map features as small as 1 to 3 mm across), but those recordings contrast with the panel and borehole maps where the minimum resolutions were typically 7-mm and 2-cm in diameter, respectively. Dust on the tunnel wall limited the minimum resolution of the panel map, but resolution in the borehole mapping was more a factor of the abundance of lithophysae and spots and of inability to resolve confidently features less than 2 cm in diameter. Data from the fraction of lithophysal cavities smaller than those measured in Slot-B and from the panel and borehole maps can be augmented with equivalent-sized cavities from Slot-A, to clarify the overall data set. Several fractures were identified in the various maps, and several fractures coincide with alignments of lithophysae (indicating temporal and spatial association during formation of those features); apertures also may have been "enhanced" during drilling or cutting. (Some mapped fractures might have been activated during mechanical fracturing of the rock during the test.)

SATURATED-ZONE STUDIES

Various elements of testing, analysis, and data compilation related to the Alluvial Test Complex (ATC) continued during the period, with submittal of material on November 12 for inclusion into the Saturated-Zone In Situ Testing AMR. Those materials included an update of the USGS analysis of the single-hole injection/pump-back tracer testing in borehole NC-EWDP-19D1 and analysis of confirmatory hydraulic tests to derive estimated leakage which could occur from the screen-#5 interval to the screen-#4 interval during pumping of borehole NC-EWDP-19D1 in future cross-hole testing. Additional material described calculation of transmissivity, hydraulic conductivity, storativity, and specific storage of the alluvium using data from cross-hole hydraulic testing. Order-of-magnitude higher transmissivity values appear consistent with high head losses observed in the pumping well. Submittals also described estimation of an upper bound on effective porosity using hydraulic and barometric pressure data sets, in the absence of data from further ATC cross-hole testing. Instruments intended for placement into borehole NC-EWDP-IM1 for background monitoring were delayed in calibration, but those instruments are expected to be placed into the borehole in early December. Monitoring for barometric response will start at that time. In the meantime, background data from

the ATC are available from the monitoring in boreholes NC-EWDP-IM1, -IM2, and -19D1 which took place from May 1 to July 3, 2002. Work continued on documentation for the hydraulic and tracer testing software.

Modeling of ground-water flow in the Death Valley regional flow system (DVRFS) continued, with emphasis on flow-model construction and calibration. The recent DVRFS knowledge exchange was summarized by USGS staff, and that summary was submitted to the NTS Project Manager and to the YMPB TPO on November 29. Preliminary drafts of the annotated outline for the DVRFS modeling report were completed, and modeling staff met with YMP staff to discuss predictive capabilities of the transient-flow model. Revisions were completed to observation and weight-generation utilities used to generate head observations and weights for the transient simulation. Those revisions included rechecking the DVRFS database for accuracy and were required by changes made to GWSI Utilities. Updated water-level information from Nye County was incorporated into the model data set. Other improvements to modeling software included refinements for generation of head observations and utilities for automation and linkage of the water-use data base to the current model discretization for development of an updated transient-well package.

Work in integration of hydrogeologic DVRFS data involved enhancement of processing routines to accommodate new data sets, to incorporate boundary conditions represented by wells, and to modify hydrogeologic-framework data sets for import into MODFLOW2000. Development work continued with staff at reVision, Inc. on importation of processing routines into the GeoPro software package. Data sets, computer code, and input files were developed to represent new constant-head boundary conditions in the DVRFS flow model, supported by USGS and U.S. Park Service staff. In addition, USGS modeling staff attended and made presentations at the Geological Society of America annual meeting, at a 3-D Geologic Mapping for Groundwater Applications workshop sponsored by the USGS, the Geological Survey of Canada, and the Illinois State University; and in the Knowledge Exchange meeting regarding DVRFS modeling. [Please note that any use herein of private firm or brand names is for identification and explanatory purposes only and does not constitute endorsement by the United State Geological Survey or other agency of the U.S. government.]

Construction and development of the 3-D hydrogeologic model also continued, with work on the DVRFS transient-model report and on efforts to refine input cross sections and grids used to build the framework model. Grids, cross sections, and unit extents were updated. Progress in hydrogeologic parameterization resulted in publication (as a USGS product) of probability distributions of hydraulic conductivity for the hydrogeologic units of the Death Valley region. That report, entitled *Probability distributions of hydraulic conductivity for the hydrogeologic units of the Death Valley regional ground-water flow system, Nevada and California*, and authored by Wayne R. Belcher, Donald S. Sweetkind, and Peggy E. Elliott, is U.S. Geological Survey Water-Resources Investigations Report 02-4212 (available on-line at http://water.usgs.gov/pubs/wri/wrir024212). Flow modelers were provided with ranges of likely hydraulic conductivity for zones of the Lower Carbonate Aquifer (LCA), with indications of importance of

depth decay in that conductivity. Other LCA updates improved depiction of zones in the northern Yucca Flat area to correct structural portrayals. Two sets of zone distinctions were developed for the Tertiary volcanic units using percentages of brittle rock and of alteration. Grids for those sets of zones were created for each hydrogeologic unit and provided to flow modelers, and documentation of the zonation arrays was compiled. New discretization of the base of the hydrogeologic framework model (HFM) set the base of the model at –4000 m, rather than the previous base at the bottom of the LCA. New sets of cells with confining units were developed on the basis of the new HFM and updated discretization. A presentation at the Geological Society of America meeting, *Relating material properties and hydraulic conductivity of Tertiary volcanic-rock units in the southwestern Nevada volcanic field, Nevada*, (by W. Belcher, D. Sweetkind, and C. Faunt), described progress in model development. Other aspects of that work were published as *Three-dimensional geological mapping and hydrogeologic framework construction, Death Valley ground-water flow system, Nevada And California* (by D. Sweetkind, W. Belcher, and C. Faunt) in Geological Society of Canada Open-File Report 1449 (edited by L. Thorleifson and R. Berg, entitled "Three-Dimensional Geological Mapping for Groundwater Applications, p. 71-74)".

Flow-model calibration utilized revisions to observation and weight-generation utilities to generate improved inputs to transient simulations. Updated water-level information from Nye County was incorporated. Utilities were developed to automate and link the water-use data base to current model discretization to support an updated transient well package. In related work, USGS staff met with DOE Office of Repository Development (ORD) staff (S. Wade, D. Coleman, and others) to discuss use of DVRFS models in work to obtain water permits for repository-construction activities.

UNSATURATED-ZONE STUDIES

Several aspects (of deferred work) in moisture monitoring in alcoves continued. The Alcove #3/Alcove #4 data package has been completed and is ready for submittal. The Alcove #7 package, partially through review, is being updated. Moisture monitoring in Alcove #7 was completed on November 15. Any additional monitoring there will be conducted under a separate work package.

In additional deferred work on the on-going close-out of surface-based borehole investigations, final QA, records, and data-management issues were resolved for the UZ borehole-data package. That package has been submitted to the data-processing group for final TPO processing.

Infiltration experiments continued in Alcove #8/Niche #3. Water application to the large-plot experiment continued and is functioning without problems. Water application has slowed, likely due to boundary conditions, and application is much slower than in the earlier trench experiment. The slow application rate may indicate that the fault helped carry water for the trench experiment, along with the fracture system. The large plot is watered only through means of a fracture system. On November 19, scales were

calibrated in place, and data loggers were changed out. The "trench unsaturated" data package and the temperature and relative humidity (TRH) package also are proceeding. The "large plot application" package has received a preliminary DTN. The data package to supercede the preliminary data package for the large plot included data to November 19 and went into processing just after that date. In addition, scientific notebook SN-120, v. 7 will be closed; a new volume will be initiated. The trench continued to drain. The pressure transducers no longer can read the tension (now below the limit of –300 mbar). A tensicorder is being used for measurements. Transducers will be extracted for calibration once tension has reached about –800 mbar (the tensicorder limit). At that time, heat-dissipation probes will be left for continuous monitoring. Routine processing of data received from the TCO continued.

Moisture monitoring continued in the subsurface, with bulkhead-related data collection and water-vapor density monitoring in the ESF and in the Cross Drift. Video data in the bulkhead data package remained in processing, as compilation of scientific notebook SN-133, v.1 continued. The checking and review process for those video data is anticipated to begin early in December. The deepest three bulkheads have not been opened, so collection and preparation of temperature, relative humidity, barometric pressure, and wind-speed data continued as well. Opening of the bulkheads and retrieval of instruments for closing calibrations may be delayed until February or March, as will the review process for those data. In the meantime, maintenance was performed on instruments, and moisture-monitoring data received from the TCO were processed. Bi-weekly camera monitoring continued, with appropriate entries to scientific notebook SN-133, v. 2. Moisture monitoring in the Cross Drift focused on comparison of preliminary water-vapor density differences in the Cross Drift. Water-vapor density increases as the ventilated air moves through the Cross Drift, indicating the surrounding rock continued to dry out. Cross Drift water-vapor density differences apparently correlate to barometric pressure in the Cross Drift. As with the bulkhead monitoring, data feeds from the TCO were processed, and data loggers were changed out at heat-dissipation probe stations in the Cross Drift.

Efforts on deferred characterization of lithophysal core continued, with preliminary analysis (visual inspection) and selection of core samples at the Sample Management Facility. Samples are selected to obtain significant amounts of lithophysal rims and spots; samples with features larger than 2 cm^2 typically are selected. Actual collection of rim and spot samples is accomplished according to SMF procedures.

Work to characterize the chemical and isotopic composition of pore water continued. In order to test the reliability of determination of the chemical composition of pore water extracted by ultracentrifugation, an experiment was devised that entailed extracting pore water, re-imbibing the sample with distilled water, and then re-extracting the water to examine the trends in chemistry. Preliminary results show that for some constituents, the water reacted with the rock so the resultant chemical composition is not a simple mixing of pure water with pore water. Further analyses and experiments will be performed to investigate this issue.

In isotopic support for thermal testing, USGS staff attended the thermal test workshop on November 6 and 7; a presentation by USGS staff described the moisture contents of samples from borehole ChemSamp-1 and chemical analysis of water extracted from that core. In addition, the chemistry of water samples collected from Borehole 75-2 was presented. Text and figures were prepared for inclusion in a white-paper report on the origin of the unusual composition of water collected from Borehole 75-2 shortly after heater turn-off. The USGS contribution (authored by B. Marshall) to that report discusses major- and trace-element chemistry as well as isotopic analyses conducted by the USGS. The water shows evidence of larger amounts of water-rock interaction than is evident in typical water samples collected from the Drift Scale Test. Additional work in isotopic support to thermal testing will resume in January after evaluation of water samples collected since heater turn-off.

On-going work, U-series delineation of UZ flow zones produced a revised draft of a report describing the U-series data and modeling on whole-rock samples. The revised draft responded to two technical reviews and now has been submitted to the USGS-YMPB publications specialist for USGS Director's approval. The report, entitled "U-series disequilibrium as a test for unsaturated-zone hydrologic models at Yucca Mountain, Nevada," will be submitted for publication in the Proceedings of the 10th annual High-Level Radioactive Waste Management Conference sponsored by the American Nuclear Society. The report, when complete, will also be submitted to YMP in fulfillment of milestone PAGSZ651M4. Checker review was completed on the data package containing U and Th concentrations as well as $^{230}Th/^{238}U$, $^{234}U/^{238}U$, and $^{230}Th/^{232}Th$ data for whole-rock samples from the ECRB Cross-Drift and the ESF. That data package has been revised and currently awaits completion of comment resolution. The package is expected to be submitted to the USGS Data Management Group early in December.

Also continuing was work on examination of microclimate using isotopic records in fracture minerals. Additional microdigestion data were collected from opal old enough to be in U-series secular equilibrium. That work was performed in response to a reviewer comment concerning the potential for fractionation between U and Th during microdigestion and implications for $^{230}Th/U$ ages. Multiple microdigestions from three different fragments had $^{230}Th/^{238}U$ activity ratios within or very close to the analytical error limits of the value expected for secular equilibrium. A possible explanation for the absence of U-Th fractionation is that the opal is rapidly dissolved by reaction with HF to form soluble fluorosilicic acid (H_2SiF_6) while liberating inherent U and Th. The absence of other constituents in opal (particularly Ca) inhibits formation of insoluble fluorides which might otherwise sequester Th preferentially over U. Therefore, the experiment indicates that previously obtained $^{230}Th/U$ ages of opal microdigestions do not contain analytical artifacts and may be considered reliable.

A report entitled "Improved spatial resolution for U-series dating of opal at Yucca Mountain, Nevada, USA, using ion-probe and in-situ microdigestion" by J.B. Paces, L.A. Neymark, J.L. Wooden, and H.M. Persing, intended for submission to the peer-reviewed technical journal *Geochimica et Cosmochimica Acta* has received two technical reviews,

been revised, and has been resubmitted for USGS Director's approval. The report describes initial results of testing growth rates related to climate cycles in the last 30 thousand years and the possible cessation of seepage in the middle or late Holocene. The report also will be submitted to YMP in fulfillment of milestone PAGSZ132M4.

Work to examine geochemical and physical characteristics of ESF dust continued, and a review draft of a report of that work was completed and submitted for technical review. The paper, entitled "Geochemistry of dust in the Exploratory Studies Facility, Yucca Mountain, Nevada," is intended for the 10th International High-Level Radioactive Waste Management Symposium to be held in Las Vegas in April 2003. The report discusses major-, minor-, and trace-element concentrations of dust samples collected in January 2002. Multiple sources of dust are present in the ESF. Approximately 95 percent or more of that dust is finely comminuted volcanic rock generated by the cutter head of the TBM, by either mechanical-miner or drill-and-blast operations during construction of niches and alcoves, and by autogenous grinding of muck during transport on the conveyor belt. The remaining fraction of the dust, which also has the greatest potential impact on the waste package, has a number of sources including (1) particulate material from diesel exhaust, (2) salts from evaporated construction water, (3) salts from evaporated pore water that migrates to the tunnel walls during dry-out, (4) abraded rubber and fiber from the conveyor belt, (5) aerosols of hydraulic fluid, oil and grease, and other fluids, (6) iron particles from emplacement of steel ribs, welding and cutting operations, and abrasion of locomotive wheels and rails, (7) concrete particles from emplacement and abrasion of inverts, (8) salts from human effluents of various sorts, and (9) exogenous dust transported into the ESF along with the supply air. Major- and trace-element analyses of size-classified completely dissolved dust samples and of water-soluble fractions show systematic trends in concentrations and inter-element correlations which appear related to the various sources of dust. The dust is enriched, relative to the Tptp, in FeO, MgO, CaO, Cl, F, CO_2, and organic C. Systematic relationships in the water-soluble Ca, Mg, Na, Cl, SO_4, PO_4, and NO_3 contents related to particle size indicate that salts of evaporated construction water and native pore water are significant components of the dust. These constituents will be dissolved when the dust is wetted or may form deliquescence compounds under conditions of high humidity. Enrichment in transition metals in the dust reflects a small but significant component of various metals in the dust load in the ESF. The dominance of finely comminuted volcanic rock in the bulk dust requires better documentation of the overall ESF rock composition to more accurately describe and estimate the amounts of soluble and insoluble components that have been added during construction.

WATER-RESOURCES MONITORING

Routine monitoring of water levels continued. Ground-water levels were measured at 34 sites, and ground-water discharge was measured at five springs and at one flowing well. Ground-water and spring-discharge data collected during October were checked and filed.

USGS Milestone Report

October 1, 2002 - November 30, 2002

Sorted by Baseline Date

Level: 4

Deliverable		Due Date	Expected Date	Completed Date
PAGSW932M4	Supplemental Fracture Data to TDB/RPC	10/25/2002	11/1/2002	11/1/2002
PAGSW258M4	Letter Report: 4th Qtr FY02	10/31/2002	10/31/2002	10/31/2002
PAGSM930M4	USGS Dir. Approval of Map of S. Expansion Area	11/8/2002	12/31/2002	
PAGSW930M4	Phase II Lithophysal Data to TDMS/RPC	11/15/2002	12/30/2002	
PAGSW931M4	Phase I Lithophysal Data to TDB/RPC	11/15/2002	12/30/2002	
PAGSM935M4	S. Expansion Area Data to TDMS/RPC	11/26/2002	1/16/2003	

USGS Milestone Report

October 1, 2002 - November 30, 2002

Sorted by Baseline Date

Level: 5

Deliverable		Due Date	Expected Date	Completed Date
PAGSM37EM5	Mtg Summary to TPO	10/31/2002	10/25/2002	10/25/2002
PAGSM37FM5	Mtg Summary to TPO	11/29/2002	11/29/2002	11/29/2002

YMP PLANNING AND CONTROL SYSTEM (PACS)

MONTHLY COST/FTE REPORT

Participant U S Geological Survey
Date Prepared 12/11/2002 02 55 PM

Fiscal Month/Year November 30, 2002

	CURRENT MONTH END						FISCAL YEAR		
WBS ELEMENT	ACTUAL COSTS	PARTICIPANT HOURS	SUBCONTRACT HOURS	PURCHASE COMMITMENTS	SUBCONTRACT COMMITMENTS	ACCRUED COSTS	APPROVED BUDGET	APPROVED FUNDS	CUMMULATIVE COSTS
1.5 02 2	8	142	1	0	29	0	140	0	15
1.5.02 2 3 2	66	1139	9	0	139	0	935	0	132
1.5 02 2 3 3	252	3094	1556	0	724	0	4277	0	515
1.5 02 2 4 3	117	3137	126	0	72	0	1430	0	262
1 5 04 6	346	3733	2299	0	1036	0	6465	0	693
	789	11245	3991	0	2000	0	13247	0	1617

U.S. GEOLOGICAL SURVEY

ESTIMATED COSTS FOR October 1, 2002 - November 30, 2002

12/11/2002 2.55:18 PM

		OCT EST	NOV EST	DEC EST	JAN EST	FEB EST	MAR EST	APR EST	MAY EST	JUN EST	JUL EST	AUG EST	SEP EST	TOTAL
4568-9U004	USGS Support to Site Description	7.3	8 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	15 32
ANSG01	USGS Support to Site Description	7.3	8 0	0 0	0 0	0 0	0 0	0.0	0.0	0 0	0 0	0 0	0.0	15 32
1.5.02 2	Natural Systems	7.3	8 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	15 32
4568-9U048	Cross-hole Hydraulic & Tracer Testing AT	27 4	27 2	0 0	0.0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	54 69
4568-9U049	Nye County EWDP Borehole Lithostratigr	12 3	10 2	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	22 58
4568-9U051	Deferred - Lithostratigraphic Support to Ny	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 00
4568-9U052	Deferred - X-Hole Hydraulic & Tracer Tstg	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 00
4568-9U053	Deferred - Map Proposed Repository Exp	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0.00
ASZG01	USGS SZ Investigations	39 8	37 5	0 0	0 0	0.0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	77.26
4568-9U082	Isotopic/Hydrochemical Support to the AT	0 0	4 1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	4.14
4568-9U083	Hydrochronology of the Yucca Mountain F	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 00
4568-9U084	Site-Scale Hydrochemistry	19 4	-0.1	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	19 37
4568-9U092	Isotope/Hydrochemical Support to Nye Co	7.7	23 9	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	31.67
ASZG02	USGS SZ Isotope Hydrology	27.1	28 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	55.18
1.5.02.2.3	Saturated Zone	66 9	65 5	0 0	0 0	0.0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	132.44
4568-9U001	Science Advisors	41.0	37.7	0 0	0 0	0.0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	78 73
4568-9U010	Publications	19 2	34 2	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	53 35
4568-9U040	Tectonics	21.5	10 3	0 0	0.0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	31 86
4568-9U041	Water Levels	3 4	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	3 41
4568-9U042	Geophysics	0.0	0 4	0 0	0 0	0 0	0.0	0 0	0 0	0.0	0 0	0 0	0 0	0.42
4568-9U060	Mapping Expertise (USBR)	14.6	8 0	0 0	0 0	0.0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	22 57
4568-9U081	Geochemistry	11.7	11.5	0 0	0.0	0.0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	23 20
819Y01	USGS Technical Advisory Capability	111.4	102 2	0 0	0.0	0.0	0 0	0 0	0.0	0.0	0 0	0 0	0 0	213 54
4568-9U050	Alcove 7/X-Drift Instrument Strains	7.8	5 5	0 0	0 0	0.0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	13.30
4568-9U063	Alcove 8/Niche 3 Infiltration	25 9	22.1	0 0	0.0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0.0	47 98
4568-9U064	Moisture Monitoring ESF & X-Drift	19.2	14.7	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0.0	0 0	33 95
4568-9U065	Bulkhead Moisture Monitoring	8.2	7.7	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0.0	0 0	0 0	15 86
4568-9U066	Support to UZ In-Situ Processes AMR	7.3	7.7	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	14 93
AUZG01	USGS UZ Moisture Studies	68.4	57.6	0.0	0 0	0 0	0.0	0 0	0 0	0.0	0 0	0 0	0 0	126.02

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		OCT EST	NOV EST	DEC EST	JAN EST	FEB EST	MAR EST	APR EST	MAY EST	JUN EST	JUL EST	AUG EST	SEP EST	TOTAL
4568-9U085	U-Series Delineation of UZ Flow Zones	26 8	5 8	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	32.57
4568-9U086	Complete Chlorine 36 Validation	5 0	13 8	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	18.72
4568-9U087	Chemical & Isotopic Composition of Pore	30 4	38 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	68 39
4568-9U088	ECRB H2O, H2O Vapor & Gas Chemistry	0 0	4 6	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	4 59
4568-9U089	Microclimate Records In Fracture Minerals	13 9	17 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	30 84
AUZG02	USGS UZ Isotope Hydrology	75 9	79 2	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	155 11
4568-9U090	Isotope Support for Thermal Testing	7 9	12 9	0.0	0 0	0 0	0.0	0 0	0 0	0.0	0 0	0 0	0 0	20 75
AUZG03	USGS Drift-Scale Test ESF	7 9	12 9	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	20 75
1.5.02.2.3	Unsaturated Zone	263 6	251 9	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	515 42
4568-9U091	Geochem/Physical Characterization of ES	2 1	2 8	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	4 98
AEBG01	USGS Effects of Water-Rock Interaction	2 1	2 8	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	4 98
4568-9U067	Quantify Lithophysal Porosity - In Situ Tes	8 1	7.5	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	15 57
4568-9U070	Deferred - Core & Lithophysae Char Tstg	0 0	0.1	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 07
AEBG02	USGS Nevada Operations Support to E	8 1	7 6	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	15 64
4568-9U068	Rock Mechanics Testing In the ECRB (US	91.5	53 5	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	144.97
4568-9U069	Fracture & Lithophysal Characteristics of	43.7	53 1	0 0	0.0	0 0	0 0	0.0	0 0	0 0	0.0	0 0	0 0	96 74
4568-9U071	Deferred - QAS & Checking Support USB	0 0	0 0	0.0	0.0	0 0	0.0	0 0	0 0	0.0	0 0	0 0	0 0	0 00
AEBG03	USBR Testing Activities in Support of D	135 2	106 5	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	241 71
1.5 02.2.4	Engineered Barrier System	145 4	116 9	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	262 33
1.5 02.2		483.2	442 3	0 0	0.0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	925 51
1.5.02		483 2	442 3	0 0	0.0	0 0	0.0	0 0	0 0	0.0	0 0	0 0	0 0	925 51
4568-9U002	Br Chief, Asst Br Chief, Deputy TPO, Tea	38 5	63 0	0.0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0.0	101 48
819Y11	USGS Branch Management	38.5	63 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0.0	0 0	101 48
4568-9U011	Reports Specialists	18 0	18 5	0.0	0 0	0 0	0 0	0.0	0.0	0 0	0 0	0 0	0 0	36 47
4568-9U012	Data Management	49 3	30 9	0.0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	80 23
4568-9U013	Records Support	22 2	2.8	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	24 98
4568-9U014	QAS Support	7 0	6 4	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	13.47
819Y12	USGS Data, Records & Reports	96 5	58 6	0.0	0 0	0 0	0 0	0.0	0 0	0 0	0.0	0 0	0 0	155 15

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4568-9U021	Administrative Support & Personnel Servi	33.2	34 8	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	68 00
4568-9U022	Facilities Management	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 00
819Y13	USGS Administration & Facilities	33 2	34 8	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	68 00
4568-9U023	Training	15 8	17.2	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	32.96
819Y14	USGS Training	15.8	17 2	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	32 96
4568-9U024	Computer/Network Support	26 4	25 5	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	51 98
819Y15	USGS Commputer/Network Support	26 4	25 5	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	51.98
4568-9U025	Property Management	24.1	20 5	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	44 61
819Y16	USGS Property Management	24.1	20 5	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	44.61
4568-9U003	Planning & Project Control	27.4	23 4	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	50.83
819Y21	USGS Planning & Project Control	27.4	23 4	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	50 83
4568-9U030	Regulatory Compliance Support	40 8	40 4	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	81 25
819Y31	USGS Regulatory Compliance Support	40.8	40 4	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	81 25
4568-9U061	Water Resources Monitoring	16 8	32 5	0 0	0.0	0 0	0.0	0.0	0.0	0 0	0 0	0 0	0.0	49 34
819Y41	USGS Water Resources Monitoring	16 8	32 5	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	49 34
4568-9U062	Safety	9.1	9 4	0 0	0.0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0.0	18 48
819Y51	USGS Safety	9.1	9 4	0 0	0 0	0.0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	18 48
4568-9U043	Hydrogeologic Data Integration	13.4	12 2	0 0	0.0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	25 56
4568-9U044	3D Hydrogeologic Model Development	1.2	0 5	0 0	0.0	0 0	0 0	0.0	0 0	0 0	0 0	0.0	0 0	1 68
4568-9U045	Flow Model Calibration and Evaluation	3 9	8.1	0.0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0.0	0 0	11 95
4568-9U046	DVRFS Knowledge Exchange Protocol	0 0	0 0	0.0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 00
4568-9U047	DVRFS Predictive Capability	0 0	0 0	0.0	0 0	0.0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0.00
819Y61	USGS Death Valley Regional Flow Mod	18 5	20.7	0 0	0 0	0.0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	39.19
1.5.04.6	DOE Technical Support Services	347.1	346.1	0 0	0 0	0.0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	693 27
1.5 04 6		347.1	346.1	0.0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	693 27
1.5.04		347.1	346 1	0 0	0 0	0.0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	693 27
1.5		**830.3**	**788.5**	**0.0**	**0 0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0 0**	**0.0**	**0.0**	**1,618.78**

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1 5 OPERATING	830.3	788 5	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1,618.78
CAPITAL EQUIPMENT	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0.0	0.0	0 0	0 0	0 0	0 0
GRAND TOTAL	830 3	788 5	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	1,618 78
FTEs													
FEDERAL	61 0	77 0	0 0	0 0	0 0	0 0	0.0	0.0	0.0	0 0	0 0	0 0	
CONTRACT	34.7	25 6	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	
TOTAL	95 6	102 6	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	